two principal moments of inertia of the orbital system. In the case under consideration $B = M/2\omega$. Eliminating B and M from (2) we get

$$T'' = -\mu \sin\alpha \cdot 2\frac{m}{e}\left(1+\frac{1}{2}\frac{\Omega}{\omega}\cos\alpha\right).^2 \quad (3)$$

If we divide this expression by $-\mu \sin\alpha$ we shall, as in the case of an ordinary magnetic field, get the intensity sought, viz.,

$$H = 2\frac{m}{e}\Omega\left(1+\frac{1}{2}\frac{\Omega}{\omega}\cos\alpha\right).^3 \quad (4)$$

The magnitudes of Ω experimentally attainable are so small in comparison with ω that the second term is always negligible.

If we assume that e/m has the value (-1.77×10^7) ordinarily accepted for the negative electron in slow motion, and put $\Omega = 2\pi n$ where n is the speed of the rod in revolutions per second, we get for the intensity per unit speed

$$H/n = -7.1\times10^{-7}\frac{\text{gauss}}{\text{r.p.s}}. \quad (5)$$

This is the *maximum* magnitude possible; if some or all of the positive ions also have orbital motion, H will be smaller in magnitude than indicated by (4), but will still be proportional to Ω. The experimental value of H/n was, within the accidental error, one half that given by (5).

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THE TRANSMISSION OF POTATO MOSAIC THROUGH THE TUBER

Mosaic of the potato is very prevalent in Bermuda on the Bliss Triumph and is the cause of serious losses to the growers, as the yield of affected plants is reduced from 10 to 75 per cent., and often a field will have a large proportion of plants with this disease.

An inspection made in July, 1914, of the fields on Long Island in which stock was being grown for shipment to Bermuda for seed purposes showed the almost general presence of mosaic on the Bliss Triumph. The same condition existed in many fields of Bliss Triumph in Maine, where the stock for Long Island is obtained. These general facts strongly indicated that the mosaic of potatoes was transmitted by the tubers, in the first case from Maine to Long Island and in the second generation from Long Island to Bermuda.

There was, however, no evidence in the literature on potato growing to support this view. Dr. W. A. Orton, in Bulletin 64 of the United States Department of Agriculture, on "Potato Wilt Leaf Roll and Allied Diseases," writes, "it is not improbable that mosaic is transmitted by the tubers" adding, however, that no experiments had been undertaken that had conclusively proved this. Experiments were consequently conducted at the agricultural station in Bermuda with a view to securing definite information on this point.

Through the courtesy of Drs. I. E. Melhus and L. O. Kunkel, of the Bureau of Plant Industry of Washington, tubers from selected hills of healthy and mosaic parents were obtained from a field at Van Buren, Maine, that was visited by the writer in September, 1914.

The tubers obtained from Van Buren were planted in Bermuda in November, 1914, in duplicate rows, and the result showed in a striking manner in January, 1915, that the mosaic of potatoes is transmitted through the planting of tubers from mosaic parents:

No. of Plants	Tubes Selected from	Percentage of Mosaic Plants
A. 200	Healthy parents	nil (4 or 5 doubtful)
B. 200	Stock on the market	80
C. 200	Mosaic parents	100

The yield from the plants affected with mosaic was less than half that of the healthy stock.

Mosaic of the potato is undoubtedly one of the serious potato problems that have escaped the notice of the practical farmer and that have until recently received little attention from scientific workers. To growers of the

[2] This equation also follows immediately from Maxwell's equation by putting in the conditions here assumed.

[3] The first term of this equation has been given previously, by Einstein and de Haas, but was obtained incorrectly, equations for a *molar* magnet instead of a *molecular* magnet being employed.

Bliss Triumph in particular it is a matter of considerable importance, and the result of these experiments shows that the disease can be readily controlled by field selection of the stock intended for planting next season.

It is believed that the experiments reported here are the first that have definitely shown that potato mosaic is transmitted through the tubers. A series of photographs have been taken which show the difference between the progeny of healthy and mosaic parents and it is intended to publish a fuller account of the experiments at an early date.

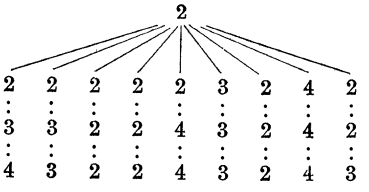
E. J. WORTLEY

PAGET EAST, BERMUDA

THE INHERITANCE OF EXTRA CONTRACTILE VACUOLES IN AN UNUSUAL RACE OF PARAMŒCIUM CAUDATUM

IN the early part of January, while examining paramœcia from a general culture maintained for laboratory purposes, it was noticed that one of the individuals had three contractile vacuoles. Further investigation showed this condition to be the rule rather than the exception, and a number of single individuals, each showing three vacuoles, were isolated with which to start pure-line cultures.

The descendants of these single individuals showed wide variation in vacuole number. In one pure line several weeks after it started 8.6 per cent. of the individuals had two vacuoles, 65.7 per cent. had three and 25.7 per cent. had four. In other cultures numbers as high as five and even six vacuoles appeared rarely. Immediately after division the average number is lower; in some very rapidly dividing cultures as many as 59.1 per cent. of the individuals may have only two vacuoles, though this return to the normal number apparently is only temporary, as the same individuals may later develop a third or even a fourth vacuole. This condition is represented by the following experiment in which an individual showing two vacuoles was allowed to pass through several divisions and then three observations were taken on each of the descendants at intervals of from four to five hours.



It is evident that all the individuals starting with two vacuoles did not later acquire a third, nor did all those having three to begin with have four before division. Those paramœcia possessing but two vacuoles, although they may divide without having shown an increase in the number of vacuoles, have not lost the power of producing extra contractile organs though several generations may be passed through before they appear.

In this multi-contractile vacuoled race the extra vacuoles are with very few exceptions located in the posterior half of the *Paramœcium*. In cases where three are present, two are found in the posterior half and one in the anterior. Only two cases have been observed in which the reverse condition was true. When four vacuoles exist the arrangement is generally three in the posterior and one in the anterior end, although there may be two in each end.

No exact observations have been made as yet on the formation of the new vacuoles. Very small vacuoles have been seen which have apparently just formed and which are usually at some distance from the others. These increase fairly rapidly in size until they reach the maximum. During the growth of some new vacuole, the one nearest to it loses temporarily its regular contraction. When the new vacuole has reached full size it beats spasmodically a few times before it settles down to its regular rhythm. Shortly the old and the new vacuoles become accustomed to the new conditions and the usual rhythmic beat begins. This is not always the case, as vacuoles have been observed to form without affecting the rhythmic beat of the older vacuoles near it in the slightest.

It is practically impossible at present to predict with certainty what number of contractile